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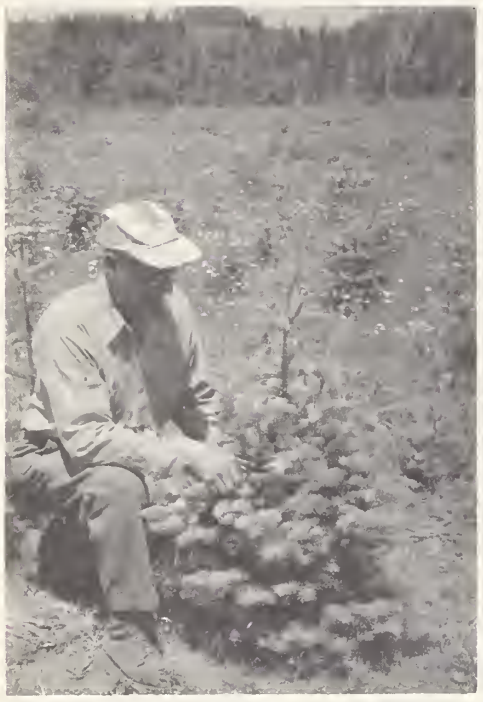
CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST



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CULTURAL PRACTICES FOR GROWING CHRISTMAS TREES IN THE PACIFIC NORTHWEST

A. INTRODUCTION

This bulletin describes various cultural practices that are used to grow quality Christmas trees in the Pacific Northwest. Many of the described practices apply to both cultured natural stands and plantations. Others apply specifically to one or the other.

More than 40% of the trees cut in the Pacific Northwest in 1959 were cultured. The trend is toward more cultured trees and fewer natural trees. This is primarily due to growing consumer demand for high quality trees. It is also caused by a scarcity of satisfactory natural trees available for Christmas tree cutting.

Cultural practices are not a cure-all for unsuitable Christmas tree sites. Many sites are too poor to produce healthy trees with good form and color. Other areas produce fast, open growth and are much better suited for growing timber than Christmas trees. Wise growers do not attempt to fight adverse tendencies on unsuitable land. They choose the best available type of Christmas tree land and apply sufficient cultural practices to attain high production of quality trees. Like any other business, Christmas tree growing is highly competitive. Competition can best be met by producing a superior product.

The cultural practices covered in this bulletin are in current use. New techniques are being developed by growers and experimenters. Techniques that work for one grower may not work for another who has different species, rainfall, slope, elevation, or soil type. Some growers produce good quality trees by thinning and pruning. Others find it necessary to resort to additional practices, such as shearing, to get desired results. It is up to each grower to determine, through trial and error, the practices which are best adapted to his Christmas tree area.

B. DEVELOPING A NATURAL STAND

Natural stands suitable for Christmas tree culture contain many thrifty young trees of Christmas tree size or smaller. A few trees may shape up quite well under natural conditions. Most of them will not develop into high quality Christmas trees unless they are cultured. Some are growing too close together for good branch development or are suppressed by competing hardwoods. Others have ample space to grow but are lopsided or spindly. By culturing suitable natural stands, the grower can improve tree quality to produce up to 20 times as many merchantable trees on the area. At the same time he can attain a sustained production, year after year, by selective removal of all trees before they exceed Christmas tree size.

1. Planning the Work

More Christmas tree operations fail through lack of good planning than for any other reason. The key to a successful operation is the development of a sound "work plan" before the job is started. The plan should be based on a careful analysis of what jobs need to be done, how they will be accomplished, and the priority of each job. Experienced growers may only need to develop a logical plan of action in their minds. Inexperienced growers are advised to write down their work plan and have it reviewed by farm foresters, county agents,

successful growers, or other Christmas tree specialists. They are also advised to get as much background knowledge as possible by reading Christmas tree prublications, participating in local farm forestry and Christmas tree associations, and looking over cultural demonstration areas.

Individual work plans will vary, of course, with both site conditions and circumstances of the grower. The following guidelines are applicable to work plans for developing most new areas:

a. Make a list of all jobs that should be done. Include those needed to develop the area and protect the trees, as well as those needed to culture the trees.

b. Decide the season that each job should be done. Culture as many trees as possible during the dormant season, August to May. Trees cultured during this period will have a head start by being prepared for the growing season. The timing for certain jobs, such as shearing pines, chemical brush control, and slash burning is closely controlled by the season of the year.

c. Give top priority to work that is needed to protect trees from serious or immediate damage. Examples might be fencing to exclude livestock, trapping and baiting to control mountain beavers, signing and patrolling to stop seasonal trespass, or burning to abate a slash hazard.

d. Culture a small trial area, say about 1/2 acre. This will permit trying various techniques, comparing tools and equipment, and making time and cost study estimates. Have the trial area examined by a Christmas tree specialist and obtain his suggestions before culturing on a larger scale.

e. Start cultural work where the most production can be accomplished and where the need is the greatest. This is usually where the greatest number of marketable trees can be cultured in the shortest time. However, in some cases, it might be older stands where trees will grow too large unless they are cultured immediately.

f. Plan realistically. Most new growers overestimate what they can accomplish. Estimated acreage that can be can be cultured each year can be computed from total work days that will be available and average per day accomplishment.

2. Hardwood Control, Space Thinning, and Basal Pruning

These 3 practices are the "musts" to develop natural stands for Christmas trees. They are often carried out as a single operation but each requires individual techniques. Most growers do this work during the dormant season, starting in late summer when new growth has hardened off. New growth during the succulent stage is easily damaged. The grower can usually plan to start marketing the trees 2 or 3 years after culturing.

Many growers find that additional cultural practices, which will be described under "pruning and shearing techniques", are also profitable but the following 3 basic practices should be done first.

A WESTERN WASHINGTON TREE FARMER IS CULTURING A NATURAL STAND OF DOUGLAS-FIR SAPLINGS BY REMOVING HARDWOODS, THINNING, BASAL PRUNING, AND SCARRING. A FEW OF THE LARGER TREES IN THE BACKGROUND ARE BEING SAVED FOR SEED TREES TO INSURE FUTURE NATURAL SEEDLINGS.

a. Hardwood control is necessary to reduce competition between Christmas trees and hardwoods for space, moisture, and sunlight. Christmas trees require open light on all sides to develop good form and vigor. Hardwood trees and brush also spread abundant seed and retard reseeding of desirable species. Larger stems are cut with chain saws, power brush cutters, or bow saws. Smaller stems are usually cut with machetes or light axes, which are also good tools for space thinning and basal pruning.

Stump sprouting can be controlled by spraying freshly cut surfaces with chemical brush killers (herbicides) such as: 2,4-D or 2,4,5-T. Pump type oil cans or garden type compressed air sprayers make satisfactory herbicide applicators. They give good spray control for avoiding accidental damage to Christmas trees. Several treatments may be necessary before roots are killed. Cutting down larger hardwood trees and spraying the stumps is a better practice than girdling and leaving them standing. Branches of dead standing trees interfere with small Christmas trees that are growing through them. Also, the dead trees will eventually decay and fall over with risk of damage to Christmas tree growing stock.

Another way to control brush and small hardwood trees is by spraying their leaves with a herbicide, using a pressure type sprayer. This treatment, called foliar spraying, is most effective in June and July. When Christmas trees and brush are so closely intermingled that foliar sprays might accidentally damage the Christmas trees, it is safer to cut the brush and spray the freshly cut stubs.

Control of different species may require different chemicals, concentrations, and techniques of application. Specifications should be obtained from the farm forester or county agent.

b. Space thinning is accomplished by removal of excess coniferous trees in order to give each future Christmas tree room to grow. Christmas

trees need full light from all sides. Crowded trees develop uneven crowns, weak branches, and suppressed foliage on whorls. Most growers strive for an average spacing of 5' which would leave about 1,740 trees per acre. Closer spacing may be utilized where a lower level of smaller trees or seedlings is being developed to replace taller pruned trees that will be cut. A good spacing guide is to allow enough distance between trees to prevent the branches of each tree from contacting or intertwining with those of its neighbors.

Inexperienced growers are more inclined to thin too lightly than too much. They frequently fail to allow extra space for growth expansion when trees require several more years to develop. In both trees the quality suffers when the branches are allowed to grow together. Wind action rubs off needles and causes abrasions, shaded needles and twigs become weak and contorted, and the crowns become lopsided.

Initial thinning often removes more trees than the number retained. This gives the grower a good opportunity to select and save the very best ones for Christmas trees. Selection should be based on natural form, density, limb structure, color, and thrift, as well as proper spacing. Certain trees appear to grow faster than their neighbors and develop an open form. These should be removed in favor of compact, bushy trees that have a natural tendency to shape up well for Christmas trees.

Once started, thinning is a continuing job. It should be repeated as often as necessary to maintain adequate spacing of potential Christmas tree growing stock. Most growers thin their stands at 1 to 3 year intervals and combine thinning with other periodic jobs such as brush cutting and pruning. Periodic thinning removes the following types of unmerchantable trees:

(1) Those growing too close together.

(2) Those that have been cultured, but for some reason fail to develop properly.

(3) Those that have grown too large for Christmas trees and which are not needed for seed trees.

(4) Species that are not in demand.

Harvesting merchantable trees is a form of thinning. Removing marketable 5- to 7-foot trees, together with some crowded smaller trees that are marketable, creates openings in the stand. However, harvesting alone seldom accomplishes the degree of thinning that is needed. Periodic thinning should be planned to remove sufficient additional trees to maintain proper spacing.

Many growers retain 2 or 3 older trees per acre for seed production to insure a perpetual crop of new seedlings to replace trees that are cut. Seed trees should be pruned high to prevent shading of the Christmas trees, but not more than 1/3 of their live limbs should be removed.

Viable seed production usually starts when the tree is about 30 years old. Selected seed trees should be full-crowned and healthy.

c. Basal pruning is the removal of unwanted lower branches between the bottom whorl of the Christmas tree and the ground. Light axes, machetes, and hand pruners are effective tools for this work.

The bottom whorl should be carefully selected because it forms the foundation of the Christmas tree. It is the first good whorl above the general level of the ferns, grass, brush, and other ground cover. The whorl should consist of 4 or more well-formed, evenly spaced branches. It should not be located below serious defects, such as imperfect upper whorls or excessively wide-spaced whorls called "goosenecks". In order to meet these standards, it is sometimes necessary to basal prune to a height of 6' above the ground.

If trees are naturally slow-growing and complete pruning below the basal whorl would be so severe as to shock and stunt the tree, one or more whorls should be left near the ground to support adequate growth. These may be gradually removed as the tree develops additional height and vigor.

THIS GROWER IS IMPROVING THE QUALITY OF A NATURAL CONCOLOR FIR IN EASTERN OREGON BY THINNING AND PARTIAL BASAL PRUNING. HE AVOIDS EXCESSIVE SHOCK TO THESE SLOW GROWING TREES BY REMOVING ONLY 1 OR 2 WHORLS OF BRANCHES BELOW THE BOTTOM WHORL OF THE FUTURE CHRISTMAS TREE.

Fast-growing species, such as Douglas-fir, may need pruning when they are only 3 or 4 years old. Slow growers, such as noble fir, may need only the handle and perhaps 1 whorl just below the handle pruned a few years before cutting. A fuller, better formed basal whorl will develop if the tree is pruned at least 2 years before it is cut.

Basal pruning accomplishes the following for your trees:

(1) Helps control excessive growth. Basal pruning shocks the tree by removing a portion of the needles, which are its food manufacturing plant. It reduces both leader length and branch length growth for several growing seasons. Studies with Douglas-fir, for example, have shown that removing half of the live crown reduced leader growth of most trees about 25% during the first growing season after pruning and about 30% during the second growing season after pruning.* Thereafter, trees gradually recover from the pruning shock and most regain a normal growth rate during the fourth growing season after pruning.**

Ideal annual leader growth for Christmas trees is generally considered 12" to 16". By trial and error, a grower learns to judge the degree of basal pruning that is necessary to maintain

*Coop. Study by Bernard S. Douglass, U.S. Forest Service, Portland, Ore., (1960-1962)

**Study by Joseph Buhaly, Wash. State Ext. Serv., Loran Curry, State of Wash. Dept. of Natural Resources, and John Hultgren, SCS, (1957-1961)

this amount of growth. His judgment in each case is influenced by past culturing experience with similar trees that grew in the same area.

(2) Gives the tree a bushy appearance. Approximately the same number of needles and buds are produced on a branch regardless of its length. When pruning causes a shorter annual branch growth, more needles and buds per inch of branch growth are produced. This gives the tree a more dense, compact appearance.

The bottom whorl needs open light and adequate growing space to stimulate strong branches, healthy needles, and new buds. Basal pruning accomplishes this in 2 ways: It develops the bottom whorl above the level of low brush, ferns, and other ground cover. It also removes competing branches that shade and suppress the inside branches of the bottom whorl.

(3) Forms an adequate handle. Basal pruning should develop a smooth knot-free handle. The handle is defined as the stem of the Christmas tree just below the bottom whorl. Its length is usually 1 1/2" per foot of Christmas tree height. Branches pruned from the handle should be cut flush with the bark to prevent both stubs and large scars.

(4) Clearly indicates the usable portion of the tree. After basal pruning the handles and crowns of the Christmas trees stand out clearly, to guide future cultural work and harvesting operations.

3. Access Roads

A main access road to the Christmas tree area is a basic requirement for culturing and harvesting. It should be constructed to all-weather standards to permit winter use. Existing public roads passing through the area may serve for main access. Private roads may also serve this purpose if they are constructed with moderate grades and adequately surfaced and drained. They have the advantage of controlling access to reduce trespass.

In addition to the main access road, a system of parallel secondary access roads should be constructed throughout the cutting area at 200- to 400-foot intervals. These roads make every portion of the area easily accessible to vehicles and workers. Road construction destroys trees and removes strips of land from production. Road locations should be designated before the area is cultured. This will avoid culturing trees that will be destroyed by road construction.

Another important purpose of roads is fire protection. This is covered under Section E. "PROTECTING THE TREES".

C. DEVELOPING A PLANTATION

1. Matching Species to Site

Most successful Christmas tree plantations have been established on cleared lands recently abandoned from growing agricultural crops. Production of highest quality trees with lowest cultural costs is usually obtained where soil is well drained, easily tilled, and low to medium in fertility. Growth characteristics of native conifers growing near the plantation site should give a clue to future growth rate and survival that can be expected for planted trees.

Slow growing species, such as grand fir, concolor fir, noble fir, shasta red fir, and Spanish strains of Scotch pine are usually best adapted to higher (more productive) sites. High sites generally have plentiful moisture, productive soil, north to east exposures, or other conditions that favor rapid tree growth.

Fast growing species such as Douglas-fir, shore pine, and most other pines usually develop best for Christmas trees on lower (less productive) sites where limited moisture, less fertile soils, climatic extremes, or southto west exposures cause relatively slow tree growth. Proper matching of species to site is one of the most important decisions for establishing a successful plantation. This subject is discussed in detail in bulletin #4 of this series "Selecting a Good Area to Grow Christmas Trees in the Pacific Northwest". Growers should consult a forester to determine which species are best adapted to their particular planting sites. Planting 2 or more species is usually a good practice. It spreads the risk of loss from insects or disease that are partial to a particular species. It also enables the grower to determine which species are best adapted to his planting site and to supply a wider market demand.

2. Jobs Preliminary to Planting

At this point it is assumed that the grower has selected a good plantation site and knows what species to grow. He is now ready to start his planting program. The following jobs should be done well ahead of planting:

a. Ground should be plowed, disced, and harrowed before planting. Summer fallowing is necessary on old fields or pastures where heavy sod has formed. Newly planted trees cannot survive competition for moisture and light with a heavy growth of grass and weeds. This problem is greatest on better agricultural soils. Another reason for eliminating grass and weed cover before planting is to destroy the natural habitat of rodents. Mice and rabbits sometimes wipe out entire plantations by girdling and nipping small trees. Grass and weeds also cause a build-up of root-eating pests such as gophers and June beetle larvae. Plowing and fallowing causes them to starve or move out of the area.

b. Planting stock should be ordered well in advance of planting and arrangements made for delivery just prior to planting.

Seedlings can be purchased from State Nurseries, c/o Oregon State Board of Forestry, Salem, Oregon, or c/o State of Washington, Department of Natural Resources, Olympia, Washington. They may also be purchased from various private tree nurseries, some of which specialize in Christmas tree stock.

c. Seedlings are packed in tight bundles at the nursery for convenience during shipment. Wet shingle tow, moss or other absorbent material is placed around the roots to protect them from drying. Water should always be poured through the bundles as soon as they arrive to replenish moisture lost during shipment. Bundles should be stored outdoors in a cool, protected spot.

Unless trees are planted within 2 or 3 days after delivery they should be removed from the bundle and heeled in where there is sufficient moisture, shade, and protection from drying winds. Instructions for this operation are enclosed with the bundle.

d. Some plantation owners have improved growth rate and survival by planting larger sized stock called "transplants". Nurseries that handle transplants sell them for about twice the cost of regular 2-year old seedlings. Where nursery-grown transplants are unavailable, they can be developed in home transplant beds from regular 2-year old nursery seedlings.

Instructions for growing transplants follow:

Select a transplant bed with the same care as used in selecting a good garden spot. Plant the seedlings 2" or 3" apart in rows. Space the rows 6" to 18" apart, depending on the type of cultivation equipment that is used. Water the transplant beds regularly during dry periods and control grass and weeds by shallow cultivation, chemicals, or surface mulching with 2" or 3" of sawdust or similar material. (If sawdust becomes mixed with the soil, it causes a loss of nitorgen. A nitroen fertilizer must then be added to the soil to restore its productivity.) After 1 or 2 growing seasons, lift the transplants from the beds and plant them permanently in the field. Growers should consider purchasing or growing transplants when husky planting stock is needed to overcome competing vegetation and drought conditions. Some of the successful growers who specialize in grand, noble, concolor, and other true firs have found that better survival of transplants more than justifies the added costs.

3. Planting Techniques

Planting requires special techniques for good survival. The local forester should be consulted. Early spring planting is usually more successful than fall planting, especially on heavy soils that are subject to frost heaving. Small acreages are usually planted by hand using a planting hoe, planting bar or shovel. One man can plant 500 to 1,000 trees per day. On larger areas, it may be cheaper to use a tractor-drawn planting machine which can plant 10 times faster than by hand. These machines are available on either a rental or contract planting basis.

Recommended spacing to grow the popular 5-, 6-, and 7-foot tall trees is 5'x5'. Although some growers prefer to plant 6'x6' to facilitate cultivating and mowing with wider equipment, this width of spacing reduces the number of trees per acre and is not actually needed to prevent crowding. A few growers start out with 3'x3' spacing and remove every other tree when it reaches table tree size. Planting in perfect squares is recommended to permit cross-cultivating and cross-mowing. This is accomplished by scoring the ground lightly in two directions before planting to mark out a square grid for a guide. Number of trees per acre for various spacing are shown below:

3'x3' = 4,840	6'x6' = 1,200
5'x5' = 1,740	8'x8' = 680

Loss of planted trees is greatest during the first year after planting. Survival of more than 95% has been experienced under very favorable conditions. On the other hand, survival of less than 50% is not unusual on very severe, soddy, or rodent infested sites. Retaining some trees in a transplant bed will provide a handy source of planting stock to replace dead trees.

Each species should be planted in separate areas rather than intermingling them or alternating the rows.

Faster growing species are apt to crowd out the slower species in mixed plantings. Mixing species also complicates cultural work and harvesting operations.

4. Weed and Grass Control

Shallow cultivation is the usual method for controlling grass and weed competition. It is particularly important during the first spring and summer after planting. It should be repeated whenever grass and weeds become re-established.

THIS CHRISTMAS TREE PLANTATION HAS BEEN CULTIVATED FOR 2 YEARS TO ELIMINATE GRASS AND WEEDS. AFTER THE SECOND OR THIRD YEAR OF CULTIVATION, GRASS AND WEEDS MAY BE CONTROLLED BY MOWING.

Substitutes for cultivation have been tried with varying success. Spraying the plantation with selective chemical weed and grass killers is a new and very promising development. When applied in proper concentrations some chemicals will not damage the trees. Best results have been obtained by spraying cultivated, newly planted ground during April or May just before weed and grass sprouts begin to emerge. The farm forester or county agent should be consulted to determine the most effective chemicals, formulas and methods of application.

Another method of grass and weed control is to apply a mulch around individual trees. Good tree survival on hot, dry sites has been obtained by using durable kraft paper cut in 2' x 2' sheets with an "X" sliced in the center. These are slipped over the top of the tree and weighted down by piling earth along the edges. Black polyethylene sheets and sawdust and other types of mulching piled around the stems have been used with varying degrees of success. Growers should compare costs and make small scale trials to compare effectiveness of various types of chemicals and mulches before making large scale applications. Two or 3 years after planting, when the trees have become well established, mowing may be substituted for cultivating to control grass and weeds. Rotary or reel type mowers that chop the vegetation finely are preferred by most Christmas tree growers. The resulting mulch decays rapidly and most of the fire hazard and rodent habitat is eliminated.

Mowing benefits the plantation by reducing root competition, eliminating shade from the lower branches, reducing fire hazard caused by dry standing grass and weeds, and removing the cover for rodents. Some growers dispense with mowing on sites where grass and weed cover is naturally light or can be controlled with chamicals. If a plantation is not mowed the following precautions should be taken:

a. Firebreaks should be constructed by plowing strips or maintaining a network of roads that are free of grass and weeds.

b. Trees should be basal pruned sufficiently high to prevent severe shading and suppression of the lower branches by grass and weeds.

c. Close observation is necessary to prevent a build-up of rodents, especially meadow mice. Baiting, trapping, or repellents may be necessary.

THIS NOBLE FIR WAS PRUNED TOO LATE. EXCESSIVE LEADER GROWTH DURING THE LAST 2 GROWING SEASONS COULD HAVE BEEN PREVENTED 3 YEARS AGO BY PRUNING OFF A FEW BOTTOM WHORLS TO SHOCK THE TREE. FURTHER SHOCKING, IF NECESSARY, COULD HAVE BEEN ACCOMPLISHED BY SCARRING.

5. Basal Pruning

Basal pruning of natural stands has already been discussed. The same principles apply to basal pruning of plantation trees. The selected bottom whorl should be located at least 9" to 12" above the ground to permit an adequate handle and, in any event, above heavy shade caused by grass and weeds.

Pruning planted trees too early stunts their growth and reduces their general vigor and ability to withstand drought and competition. Therefore, it is advisable to postpone any trimming of branches, except removing multiple leaders, until indications first show that next year's leader growth will exceed 14" in length. However, it is equally important to basal prune in time to help retard excessive leader growth.

6. Adequate Moisture

Natural moisture conditions west of the Cascades are usually sufficient for established trees. However, newly planted trees are frequently killed by prolonged summer drought. Grand, noble, concolor, and other true firs are much more susceptible than pines. Douglas-fir is intermediate in drought resistance. Sprinkling, flood irrigation, or watering individual trees during dry periods will save many of them. Drought susceptible species can also be helped by planting on north and east exposures, clean cultivating, mulching, and inserting a shingle for shade on the southwest side of newly planted seedlings.

D. ADDITIONAL CULTURAL TECHNIQUES

The following cultural practices may be applied to either cultured natural stands or plantations:

1. Crown Pruning

Crown pruning consists of the removal of unwanted branches in the crown of the Christmas tree. Some crown pruning practices are:

a. Removal of multiple leaders. When the top of a tree produces 2 or more leaders, all but the best one should be cut off close to the main stem. Multiple leaders are produced when the terminal bud or leader is broken off or injured. They also develop on some small seedlings.

b. Removal of suckers. Suckers are formed by lateral branches or large sprouts that turn upward along the side of the stem. They conflict with the horizontal pattern of normal branches and should be cut off close to the stem.

c. Removal of unwanted branches. Any branches that do not conform with the desired shape, symmetry, or density of the tree should be removed or cut back. Examples are branch tips that are abnormally long or those that turn back toward the main stem of the tree.

2. Scarring

This is a means of slowing growth rate by intentionally injuring the cambium layer under the bark to cause shock. Trees should never be scarred unless excessive growth threatens to become a problem. The principal purpose of scarring is to reduce the growth rate of trees that have recovered from the retarding effects of basal pruning. It may also be done at the same time as basal pruning on fast growing trees when growth would not be sufficiently retarded by basal pruning alone.

a. Basal scarring is the most frequently practiced type of scarring. A strip of bark 4" to 12" long is skinned off the lower stem with an axe, machete, or knife. The scar should be 9" or more below the bottom whorl to avoid disfiguring the handle. Sufficient pruned stem length for scarring, as well as forming a handle, should be considered when basal pruning.

Scarring may be done at the time of basal pruning or at any other time that excessive height-growth becomes a problem. The more severe the scarring, the more pronounced will be the next season's growth reduction. Heavy scarring is 6" to 12" long and girdles the stem circumference, a maximum of about 60%. Light scarring is only 3" to 6" long and girdles the stem about 20%.

b. Leader scarring is a less frequently used method of scarring in which 1 or 2 strips of bark are sliced from the base of the leader. Care must be taken not to slice too deeply as this may weaken the leader and cause breakage. This type of scarring may reduce next year's leader growth, but does not slow the growth of lateral branches below the scar. Some growers have obtained good results with this technique. Others, especially those culturing trees on fast-growing sites, have been unable to check excessive leader growth.

3. Leader Pruning Firs and Spruces

Leader pruning consists of cutting back excessively long leaders to proper lengths. If this is not done, wide growth intervals called "goosenecks" are formed between the whorls.

These are a major cause of skimpy, poor quality trees. Leader pruning is also used to arrest height growth of fast growing trees and force internodal branches to fill in the goosenecks. Tips of main lateral branches should be sheared back at the same time to prevent multiple leaders and to restore a uniform taper.

A few problems may result from leader pruning. Although not always serious, they should be anticipated by a grower who plans to do this work. First, he should realize that false whorls are seldom as symmetrical as true whorls formed at the tips of unpruned leaders. A small crook or "dogleg" will form on the new leader just above the cut. Leader pruning, together with the necessary branch shearing, is more costly and painstaking than preventing excessive leader growth by basal pruning and scarring. For these reasons many growers prefer to prevent, rather than correct, excessive leader growth.

Unlike pruned leaders of pines, which will form a new cluster of buds just below the point of cutting, pruned leaders of firs and spruces must develop new growth from existing internodal buds at intervals along the stem. Two very exacting techniques have been developed to correct excessively long leaders on firs and spruces without causing multiple leaders or unsymmetrical whorls of branches.

a. Forming a false whorl.

A cluster of 4 or more evenly distributed internodal buds is selected on the leader at a point 12" to 16" above the top whorl. It is not necessary that all the buds in the cluster arise from the same level on the leader--they may be scattered over a span of 2" or 3". Next, a single strong internodal bud is selected at least 2 1/2" above the bud cluster. Any additional buds

TECHNIQUE FOR FORMING A FALSE WHORL IS ILLUSTRATED ABOVE.

1. LOCATE A CLUSTER OF 4 OR 5 BUDS APPROXIMATELY 12" TO 16" ABOVE THE TOP WHORL.
2. CUT THE LEADER 1/8" ABOVE A STRONG SINGLE BUD LOCATED 3" OR 4" ABOVE THE CLUSTER. REMOVE ANY SURPLUS BUDS BETWEEN 1 AND 2.
3. CUT BACK THE BRANCH TIPS OF THE TOP WHORL ABOUT 1/8" ABOVE A PAIR OF BUDS.

THE FALSE WHORL SHOWN ABOVE WAS PRODUCED DURING THE FIRST GROWING SEASON AFTER TREATMENT. THE SCAR WHERE THE LEADER WAS CUT IS BEING POINTED OUT.

between the bud cluster and the top bud are picked off to discourage the formation of multiple leaders. A pocket knife or hand pruner is used to cut off the leader at a 45° slant, leaving the single top bud 1/8" below the high point of the cut. This bud forms next year's leader and the cluster of buds below it will develop into lateral branches which simulate a true whorl.

At the same time the leader is pruned, the branch tips of the top whorl should be either disbudded or sheared back a few inches above a pair of buds. This will keep the branches from turning up to form multiple leaders. It will also keep the width of the tree in good balance, since the branches of a false whorl grow only about 2/3 as long as those of a true whorl during the first year.

b. Succulent leader pruning followed by regrowth.

Succulent leader pruning is accomplished by cutting off the top of the leader during early summer when the new growth is still tender. This work is begun in about June when the new leader shoot has barely completed its growth. Since the succulent stage lasts for only a few weeks, this work must be completed during that period to be successful.

The tender leader should be cut off just above a lone internodal bud in a manner similar to that described for forming a false whorl during the dormant season. Internodal buds appear as tiny scales during the succulent stage and are somewhat difficult to see. About 50% of the time a short sprout of regrowth called a lammas shoot, will form during late summer from the top bud just below the cut. This regrowth is essential to make the system work, since it produces normal terminal buds like those on an unpruned leader. By selecting the proper pruning length and allowing an inch or two for the regrowth sprout, it is sometimes possible to obtain desired spacing between whorls. However, a good precaution is to leave a bud cluster a few inches below the cut when succulent shearing. This will permit development of a false whorl in those cases where a regrowth sprout does not occur.

THE POINT IS INDICATED WHERE A DOUGLAS-FIR LEADER WAS PRUNED 3 MONTHS EARLIER DURING ITS SUCCULENT STAGE OF GROWTH. DURING THE SUMMER A REGROWTH SPROUT FORMED FROM A BUD JUST BELOW THE CUT. THE TIP CONTAINS A PERFECT BUD CLUSTER TO FORM NEXT YEARS LEADER AND BRANCH WHORL.

4. Shearing Firs and Spruces.

Shearing is the practice of cutting back the tips of lateral branches. It stimulates bud production and results in greater density of foliage. It is also used to narrow the taper of excessively wide trees and to make lopsided trees more symmtrical. Some growers have produced good quality in fast-growing trees by a combination of leader pruning and shearing the laterals to allow the internodal branches to fill in the spaces between the whorls.

Many growers have found that shearing is one of the most important cultural practices to produce high quality trees. Other successful growers who work with different species or under different growing conditions have found that shearing does not pay. If trees are naturally slow-growing, well-shaped, bushy, and compact, shearing would do little to improve them.

Two methods of shearing are practiced on firs and spruces.

a. Random shearing is the shaping of a tree with a hedge shears or long-bladed knife to a uniform cone. Most trees are shaped so that the spread of the lower whorl is 3/4 of the tree height, a taper of 75%. Taper may vary from 50% to 100%, depending on species and consumer preference. After shearing, new branches develop from internodal buds along the stem. They will conceal the stubs after about 2 growing seasons. Most growers do this type of shearing during the dormant season but a few growers shear during the succulent period when knife shearing is most efficient and resulting stubs are less noticeable. Very severe or frequent random shearing causes trees to become extremely heavy, dense and hedge-like. At present the demand is greater for light to moderately sheared trees, which are more natural in appearance.

The greatest advantage of random shearing is low cost and simplicity. The disadvantages are that 2 growing seasons are required to hide the stubs and the branches lack symmetry.

b. Fork shearing is the removal of last year's growth tip from lateral branches to arrest lateral growth and force growth of secondary branches. The cuts should be made very close between the branch forks to prevent a visible stub. Branches sheared in this manner become attractive and fan-shaped when the lateral branches develop new growth. Since the top whorl is unbranched and cannot be fork sheared, the terminal bud on each branch should be picked off to prevent a flared top and preserve an even taper.

Fork shearing can be used effectively to correct lopsided trees. Symmetrical shape can be obtained by fork shearing to remove 1 or 2 year's growth tips on the wide side of the tree and only disbudding or not working the narrow side. Fork shearing is also useful to narrow the taper of excessively wide trees, such as some grand firs. As much as 2 or 3 years of unwanted growth can be removed from the ends of abnormally long branches if care is used to prevent stubs.

FORK SHEARING PRODUCED THIS ATTRACTIVE, FAN-SHAPED BRANCH. A SMALL SCAR IS SHOWN WHERE THE BRANCH TIP WAS CUT 2 YEARS AGO TO ARREST EXCESSIVE LATERAL GROWTH AND TO PROMOTE A DENSER BRANCH STRUCTURE.

Cost of fork shearing exceeds that of random shearing, but may be justified by the neat, symmetrical appearance and the opportunity to market the tree after only one season's growth.

5. Disbudding firs and spruces

Disbudding is the practice of pinching off the terminal, or middle bud, from the bud cluster at the tip of main lateral branches. (The terminal bud on the tip of a leader should never be removed, since this would cause multiple leaders to form.) Branch growth resulting from disbudding is quite similar to that of fork shearing. It prevents the growth of the main branch tip and allows 2 or more secondary branches to form on each lateral. Lateral growth is slowed down and growth of secondary (internodal) branches is stimulated. Irregular shape of trees can be corrected by using a combination of fork shearing and disbudding.

6. Shearing Pines

Shearing of pines includes cutting back both the leaders and lateral branches in a single operation. It is widely practiced in the Lake and Eastern States to improve shape and density. Shearing of pines is beginning to gain acceptance in the Pacific Northwest, particularly when a dense type of tree is desired. It should be started when, but not before, natural leader growth exceeds about 14". In natural areas, this stage of development usually occurs when trees are 2' to 4' in height. In plantations, it usually occurs during the third growing season after planting. Pines should be sheared only during the succulent stage from about June 15 to July 15. Shearing should begin when elongation of the succulent growing tips (candles) is nearly complete and the new needles are about half elongated. Shearing should stop when the new succulent growth begins to harden off and bud formation is no longer dependable. In about 6 weeks, tips of branches sheared during the succulent stage will form complete new bud clusters at the base of needles.

PINES HAVE THE UNIQUE ABILITY TO PRODUCE COMPLETE NEW BUD CLUSTERS ON TIPS OF BRANCHES AND LEADERS THAT ARE SHEARED DURING THE SUCCULENT STAGE OF GROWTH. THE ABOVE BUDS FORMED DURING LATE SUMMER ON A PONDEROSA PINE LEADER THAT WAS PRUNED BACK IN JUNE. THE SCAR IS VISIBLE WHERE THE LEADER WAS CUT ON A 45° ANGLE.

Recommended succulent shearing techniques for pines are as follows: Using either a hedge shears or a long, thin breadknife, the leader is cut off on a 45° angle to a sheared length of about 14". Next, the top whorl is sheared to about half the length of the leader, or about 7". Some growers gather all the branches of the top whorl together in one hand, pull them upward, and cut them to the same length with a single knife cut. Others shear the branches individually. In either case, the lower laterals should be sheared back as part of the same operation to form a near perfect cone with a taper of 60% to 70%. Shearing once started should be continued each year

during the succulent stage. If multiple leaders form, all except the best one should be either removed or sheared to the same length as the laterals. The last shearing before the tree is cut should be done lightly and skillfully to prevent visible stubs and a cropped appearance.

THIS SHORE PINE HAS COMPLETED ITS THIRD GROWING SEASON IN THE PLANTATION. IT IS READY FOR ITS FIRST SHEARING, AS INDICATED BY A LEADER GROWTH OF MORE THAN 14". IF THE TREE IS NOT SHEARED AT THIS TIME, IT WILL NOT DEVELOP A COMPACT BRANCH STRUCTURE.

THE SAME TREE IS SHOWN AFTER SUCCULENT SHEARING WITH A SHARP BREAD KNIFE. THE LEADER WAS CUT BACK TO 14" AND THE TOP WHORL TO 7". TIPS OF REMAINING LATERAL BRANCHES WERE TRIMMED TO DEVELOP A CONICAL SHAPED TREE.

7. Root Pruning

Root pruning has been used by nurserymen for many years to slow growth and develop compact roots on ornamentals. Perhaps certain applications of root pruning, such as cutting the shallow feeder roots, might be used to control the growth of Christmas trees. To test this possibility, a few studies* were made to observe the response of 3' - 10' tall Douglas-firs to root pruning. Some trees were root pruned to the depth of a shovel blade in a complete circle around the tree 2/3 of the distance from the stem to the drip line. Others were root pruned in a similar manner, but on only 2 sides of the tree. This would simulate root cutting by a coulter or ripper operated between plantation rows.

*Leader Growth Control Studies for Douglas-fir Christmas Trees, by B. S. Douglass, U.S. Forest Service (1960)

Root pruning in a complete circle caused too drastic shock for most trees, as evidenced by chlorosis (yellowing of the needles) and excessive stunting (more than 50% growth reduction). Trees that were root pruned on only 2 sides responded much better. Growth rate was reduced only about 25% and few trees showed discoloration.

Root pruning should be limited to small scale trials until it is more thoroughly tested. More information is needed in techniques and growth response, particularly on fast growing plantations where root pruning appears to offer possibilities.

8. Stump Culture

Stump culture is the practice of developing a new Christmas tree from a limb or sprout left on the stump after a Christmas tree has been cut. To make this system work, several strong branches or sprouts should be left on the stem below the handle. A year or two after the tree is cut, they will turn upward and form multiple leaders. The most promising one is then selected to produce a new tree. Remaining branches are pruned back or removed to reduce competition. Some growers have produced 3 or 4 successive Christmas trees from a single stump.

Pines are the most dependable for producing a new tree from a turned up limb.

The results for Douglas-fir are variable. Sometimes a lower limb will develop properly, but more reliable results are usually obtained from a newly formed sprout.

True firs, such as grand, concolor, and noble, are very reluctant to form a new tree from an upturned branch. Much better results for these species are obtained by developing a newly formed stump sprout. A few lower limbs are left on the stump, as with other species, but their only purpose is to sustain the vigor of the root system until a sprout is produced.

For all species, shock to the root system can be reduced and the development period for a new tree can be shortened by "training" a branch or sprout for several years before the tree is cut.

Since stump cultures usually do not shape up as reliably as natural trees, they are more often grown by necessity than by choice. Few growers bother with stump cultures in cultured natural stands where natural seedlings are plentiful. However, some situations favor growing stump cultures. These include areas where survival conditions for planted seedlings are poor or where natural seedlings are scarce. Other possible advantages are the creation of mixed-age stands from even-aged plantations or the perpetuation of Christmas tree production from trees having superior genetic characteristics.

9. Fertilizing

Fertilization is a relatively new cultural aid. It is used to improve color, luster, and density of needles and to increase growth rate of leaders and branches. Slow growing trees with light, off-color needles and weak branches are most likely to benefit. Such trees are most frequently the result of low fertility and summer drought.

Fertilizers must be used with caution. On some sites they may do more harm than good by causing trees to grow too fast or by stimulating rapid growth of competing vegetation. Large scale applications should not be made until sufficient small trials have proven the effectiveness of the application under local conditions. Nitrogen fertilizers have proven more beneficial to Christmas trees in most parts of the Pacific Northwest than mixed fertilizers which also contain

phosphate and potash. Urea (46% nitrogen) is a very concentrated form of nitrogen fertilizer. Other nitrogen fertilizers are ammonium nitrate (33% nitrogen) and ammonium sulphate (20% nitrogen). The County Agent can assist in determining the correct amount of any nitrogen fertilizer to apply to obtain a desired amount of available nitrogen. For example 1.09 lbs. of urea fertilizer is required to provide 1/2 lbs. of nitrogen.

Fertilizers have 2 purposes, both of which require separate techniques. Instructions follow:

a. Improving color without stimulating growth.

Fertilize after early summer growth has stopped but before fall rains begin. This is usually between mid-June and mid-August. Either urea or ammonium nitrate is effective where the fertilizer is applied in late summer just before fall rains begin. Ammonium nitrate is recommended for early or mid-summer applications because it does not deteriorate under long time surface exposure prior to leaching into the ground.

Fertilize only those trees that you plan to cut for the Christmas season following the fertilizer application. Fertilizer should be scattered evenly under the drip line. The tree will pick up sufficient nitrogen after the first rains to develop a dark green color. Nitrogen requirements will vary with site, species, and tree size. Trial spreads of 1/16 to 1/2 lbs. (nitrogen weight) per tree should be made to determine the least amount that will give good color.*

b. Improving both color and growth rate

Fertilize in early spring when buds first begin to swell, usually in April. Much of the nitrogen is leached out of the soil when fertilizer is applied earlier during the dormant season. If the ground is relatively free of heavy fern, salal, grass, and other competing vegetation, broadcast the fertilizer evenly under the drip lines of the trees. Where heavy competing vegetation does occur, fertilizer may be applied in 3 or more evenly spaced piles about half way between the stem and the drip line. This will help reduce the take-up of nitrogen by other plants.

When trees are fertilized in the spring, they will respond during the first growing season. Increased growth and heavy, dense, dark green needles will occur. This stimulation continues after the original fertilizing for several additional growing seasons. Experiments in a Douglas-fir Christmas tree area near Shelton, Washington caused increased leader growth of more than 25% during the first growing season after fertilizing and nearly 100% during the second growing season.*

Similar experiments on a very slow growing site on the Kitsap Peninsula in Washington produced increased leader growth after the first growing season of about 100%, with a nitrogen spread of 200 lbs. per acre, which was the minimum amount that gave good color.**

*S. P. Gessel, J. W. Duffield, and R. K. Campbell, University of Washington, Results of Christmas Tree Fertilizer Experiment (1955) (Unpublished)

*Wm. Looney, Simpson Timber Co. (1959-1961)

**Dino Sivo, Joseph Buhaly, and Dr. C. B. Harsten, Washington State University (March 1961-not concluded)

On this adverse site, where additional color and growth were both needed, the first year's results were very satisfactory. However, where existing growth is adequate, fertilizing may cause excessive growth unless the trees are harvested during the first Christmas season after fertilizing. The amount of fertilizer needed to obtain desired color and growth response will vary with site, species, and tree size. Only trial and error will establish the correct amounts for each area.

Suggested trial spreads for broadcasting are 100, 200, 300, and 400 lbs. of nitrogen per acre. Suggested trial applications for individual trees are 1/8, 1/4, 3/8, and 1/2 lbs. of nitrogen per tree. Single tree application on the Kitsap Peninsula in Washington produced dark green color with as little as 1/4 lb. of nitrogen per tree.*

E. PROTECTING THE TREES

1. Animals

Livestock should be excluded from Christmas tree growing areas. A good fence provides protection against browsing and trampling by cattle, sheep, goats, and horses.

Deer are frequently a serious problem, particularly where they become too numerous for available supplies of the more palatable types of forage. Leaders and branch tips deformed by deer can be identified by ragged or stringy breaks where the twigs have been browsed. In certain areas, elk produce a similar type of damage. (Rabbits, mountain beaver, and other rodents clip off the branches with clean cuts made at an angle.)

Deer also scrape off bark and break branches by rubbing the trees with their antlers. If deer become a serious problem, the State Game Department may be able to reduce the deer population by extending hunting seasons or issuing special control-hunt permits. High, deer-proof fences are effective, but they are costly to construct and maintain. Several spray-type deer and rodent repellents are available. However, these lose their effectiveness when trees put on a new season's growth and are costly to apply on larger trees.

Rodents are enemy No. 1 to many growers. Meadow mice are particularly troublesome in grassy plantations. They girdle small trees close to the ground. Several weeks or even months may pass before needles of girdled trees turn brown and the grower becomes aware of the extent of the damage. The most effective control is to destroy the mouse habitat by removing grass and weeds from around the base of the trees. Where habitat control is impractical, water-proof bait stations should be set out at about 40 foot intervals.

Rabbits and mountain beaver cause serious damage in some areas by clipping branches. Three methods are used for control:

a. Baiting.
b. Trapping.
c. Altering the habitat.

Habitat can be altered by clearing or burning log piles, slash accumulations, brush patches, and other protective cover in the area.

*Darrell Turner and Joseph Buhaly, Washington State University (May 1961-not concluded)

Pocket gophers sometimes gnaw and girdle tree roots, causing the tree to die or tip over. This problem most frequently occurs in plantations that are established in old fields. The most effective controls are:

a. Elimination of the fleshy weeds on which gophers feed.
b. Trapping.
c. Underground baiting.

Information on the identification and control of rodents may be obtained from the Farm Forester or County Extension Agent.

2. Insects and Diseases

Light and spotty occurrence of insects and diseases is a normal condition on most Christmas tree operations. This condition should not cause alarm. However, growers should constantly be alert for any signs that an insect or disease is starting to get out of control. Danger signs are loss of vigor, dropping or discoloration of needles, webs, spittle, deformed or dying shoots, unusual build-up of insects, and visible fungi fruiting bodies.

Prompt control measures may be necessary to prevent a costly epidemic. The longer you delay, the more costly and difficult control may become.

Frequently, the outward signs of insect and disease damage are quite similar. The first step to take when a build-up occurs is to have the disease or insect identified. Growers should consult with the Farm Forester; County Agent; or Section of Insect and Disease Control, U.S. Forest Service, P.O. Box 4137, Portland 8, Oregon. These people can help growers identify the cause of trouble and recommend methods to control the responsible insects or diseases.

a. Insects

Certain insects, such as white grubs and root weevils, attack the roots of trees. Aphids, spider mites, bud worms, tip moths, wooly aphids, scales, needle miners and caterpillars attack the buds and needles. Twig weevils burrow into the pith and kill shoots or small branches.

Usually insects attack only occasional trees and cause a lowering of Christmas tree grade rather than outright culling. However, a sudden increase in the number of insects is a real danger signal. Most insects can be controlled by application of an insecticide. Cost of controlling insects is usually small compared with the value of trees that might be lost during an epidemic.

b. Diseases

The most common disease to Douglas-fir Christmas trees is "needle cast disease" (Rhabdocline). This fungus causes needles to turn brown and drop off prematurely. Individual trees vary in natural resistance. Those that become lightly infected in ordinary years will likely become badly defoliated during years favorable for the spread of the disease. Control measures consist principally of removing noticeably infected trees. Some growers report that fertilizing increases the resistance of their trees to infection.

A form of blister rust "Western gall rust" causes cankered swellings on the branches of lodgepole and shore pines. Orange spores develop on some of the swollen areas. The cankers eventually girdle and kill the branch. The best control measure is to cut out infected branches or harvest merchantable infected trees before the branches die. A similar but more deadly

disease "white pine blister rust" attacks white and other 5-needle pines. Control with antibiotics is possible, but difficult and costly. Production of 5-needle pines in most areas in the Pacific Northwest may be a poor risk for Christmas tree growers.

Other diseases are usually of relatively minor importance. Root diseases occasionally kill small groups of trees. Certain needle cast, needle rust, and twig blight diseases may cause needles of true firs and pines to die and shed prematurely. These diseases are found most frequently on crowded and suppressed trees. Thinning and removal of badly infected trees will increase the vitality and resistance of remaining trees.

3. Fire

An uncontrolled fire can destroy years of hard work and investment in just a few hours. Adequate fire precautions are one of the best insurance investments that a Christmas tree grower can make.

Both cultured natural areas and plantations have fire problems. However, the hazard is usually greater for natural areas where accumulations of slash, brush, rotten logs, and other flammable debris are the rule. Grass fires are the main fire problem on plantations. Fire prevention and control for both types of operations will be considered separately:

a. Cultured natural areas

The most effective fire control measure is a network of access roads through the area. Roads provide effective firebreaks to help confine fires to a small area. They also permit quick access for fire fighters and fire fighting equipment. In order to remain effective as firebreaks, roads should be bladed regularly to keep them free of ferns and other flammable debris.

Roads have little value as firebreaks unless snags are felled. Burning snags throw sparks which cause rapid spread of fire and may easily be blown across firebreaks by winds and drafts. Roads can also be made more effective as firebreaks by burning adjacent heavy slash concentrations during safe periods. Burning permits from the district warden are required during most of the year.

Some Christmas tree areas are too steep to construct vehicle access roads directly up the slope. In this case, a system of well-drained fire trails might be needed around steep portions of the perimeter or between upper and lower levels of access roads.

Culturing creates a fire hazard from pruned branches, thinnings, and cut hardwoods. Piling and burning slash concentrations on the entire area is desirable but usually the cost of doing this is prohibitive. As a minimum compromise, growers should pile and burn in strips along the main firebreaks. Elsewhere, they should lop the limbs from felled trees so the slash will be close to the ground. This will hasten its decay.

Posting of lands against trespass and controlling access over private roads may prevent some man-caused fires. It also reduces the chance of tree theft.

Growers can facilitate fire suppression by providing a cache of fire tools in a central location. Water holes and ponds may also be developed for an emergency water supply.

If a fire does occur, it should be reported immediately to the State District Warden or District Administrator. In farm areas not covered by State fire protection, the Rural Fire District Headquarters should be notified.

b. Plantations

Dry grass and weeds are the greatest fire threat to plantations during late summer and fall. Prolonged dry periods during winter and early spring also cause flammable conditions.

The best precaution is the elimination of grass and weeds by cultivating, mowing, or by application of chemical grass and weed killers. Where this cannot be done, firebreaks should be plowed or disced to expose mineral soil. They should be constructed along unprotected portions of the perimeter of the plantation, along public roads where man-caused fires are most apt to occur, and through the plantation to divide it into smaller units for easier control of fires. Grass and weed fires spread rapidly and require fast action to control them. Plows or discs, if readily available, can be used to construct a line around fires. Small fires can often be controlled by beating them out with wet burlap sacks, flat shovels, or even a flail made from a heavy evergreen branch.

4. Trespass

Tree theft is a seasonal problem which occurs during 2 or 3 months before every Christmas. This problem is less troublesome when the Christmas trees are growing on your home property and can be watched. The best solution for absentee owners is to establish the operation on a private road with controlled access. Where this is not possible, signs, fences, and locked gates are inexpensive and usually effective precautions. Growers should also obtain the cooperation of neighbors and local law enforcement officials who can help watch for trespassers. More costly precautions such as a hired watchman or special fencing may be necessary in problem areas. The theft of trees is gradually becoming less frequent because of a growing public awareness of private property status of Christmas trees and penalties for violation of State and County trespass laws. The press, radio and television, as well as public and private forestry organizations, are doing a good job of informing the people about the laws and regulations. Law enforcement agencies are also cooperating by checking and investigating violations.

F. IMPROVED TREE STRAINS

Geneticists and nurserymen are seeking better Christmas tree strains for tomorrow's growers. Just as ornamental shrubs with special desired characteristics were developed from the original wild plants, superior Christmas trees will eventually be developed from selected natural trees. Two major aims of the genetic improvement of Christmas trees are greater beauty and "self-shaping" to eliminate a great deal of costly cultural work. Needless to say, tree strains that produce good timber do not necessarily produce the best Christmas trees. Improvement of Northwest species for better Christmas trees is still in its infancy.

Scotch pine has received somewhat more attention than native species. This species grows naturally over most of Western Europe. Its great geographical variation in needle color and length, growth rate, branching habit and other inherited characteristics have been intensively

studied. The Southern European French Auvergne and Spanish strains with short blue-green needles are in greatest demand. Reliable Christmas tree nurserymen indicate the strains or characteristics of their planting stock. Some nurserymen collect their own seed from desirable parent trees to insure a reliable seed source.

Occasional individual Douglas-fir, noble fir, grand fir, concolor fir, shore pine, and other native Christmas trees are found with near-perfect symmetry, density, growth rate, and color characteristics. Such desired trees may be propogated vegetatively in several ways:

1. Stump culture.
2. Grafting cuttings on rootstocks of ordinary trees of the same species.
3. Rooting of cuttings.

All of these practices preserve the characteristics without change. Growers who find these rare trees are advised to save them for future production and breeding work.

Some interest has also been shown concerning the development of seed orchards in which cuttings from desirable parent trees are grafted for cross-pollination and seed production. However, seed orchards are costly to establish and the resulting seeds require thorough testing to assure that the grafts breed true to type. While perhaps many years away, this method of seed production may eventually offer opportunities for improved planting stock.

G. SOURCES OF ASSISTANCE AND INFORMATION

Services of a farm forester are available to most woodland areas in Oregon and Washington. The office address of the local farm forester can be obtained by inquiring at any State Forestry Department office in Oregon or State Department of Natural Resources' office in Washington.

Reference material is available from the County Extension Agent. He can also advise growers concerning the availability of assistance from farm foresters, extension foresters and others who work with Christmas tree growers.

Additional sources of Christmas tree culturing information are:

Extension Forester
206 Forestry Bldg.,
Oregon State University
Corvallis, Oregon

Extension Forester
Agricultural Extension Service
Western Washington Experiment Station
Puyallup, Washington

Extension Forester
Agricultural Extension Service
Washington State University
Pullman, Washington

Local offices of the Soil Conservation Service.

U.S. Forest Service, P.O. Box 3623,
Portland 8, Oregon

Northwest Christmas Tree Association (The name and address of the current secretary may be obtained by contacting a farm forester or the U.S. Forest Service at the above address)